PATENT
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IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant:	Katsunori KANEKO et al.	Conf.:	4015
Appl. No.:	09/188,190	Group:	3748
Filed:	November 10, 1998	Examiner:	Nguyen, Tu Minh
For:	EXHAUST GAS PURIFYING APPARATUS OF AN INTERNAL COMBUSTION ENGINE (AS AMENDED)		

BRIEF ON APPEAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

April 25, 2006

Sir:

Appellants hereby appeal the Final Rejection of the Examiner issued August 25, 2006.

I. Real Parties in Interest

The real party in interest by assignment is Mitsubishi Jidoshoi Kogyo Kabushiki Kaisha.

II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of Claims

The status of the claims is as follows:

Claims 1-2:	Cancelled
Claims 3-4:	Rejected and under appeal
Claim 5:	Cancelled
Claims 6-24:	Rejected and under appeal

IV. Status of Amendments

No Amendments under 37 CFR 1.116 have been filed.

V. Summary of Claimed Subject Matter

Appellants' invention is directed to an exhaust gas purifying apparatus of an internal combustion engine. The claimed invention is described in relation to the following claims:

Independent Claim 23: Claim 23 is directed to an exhaust gas purifying apparatus comprising:

a light-off catalyst 11 provided in an exhaust passage 3 and having an O_2 storage capability such that said light-off catalyst passes, there through, at least CO in an exhaust gas to a downstream side of the light-off catalyst when the internal

combustion engine is operating under a condition where the oxygen concentration of the exhaust gas is reduced;

exhaust gas purifying means 6 provided in the exhaust passage 3 at a downstream position of and in series with said light-off catalyst 11, the exhaust gas purifying means 6 having a NOx catalyst 13 for adsorbing NOx in the exhaust gas when an air-fuel ratio of the exhaust gas is lean and releasing the adsorbed NOx when the oxygen concentration of the exhaust gas is reduced, said exhaust gas purifying means 6 further having a three-way catalyst 14 that reacts with the released NOx;

wherein the light-off catalyst 11 has an oxygen storage capability of a first value and the three-way catalyst 14 of the exhaust gas purifying means 6 has an oxygen storage capability of a second value greater than said first value, said first and second values being per one liter of catalyst;

and

NOx regeneration control means 20, 21, 22, 23, 24, 25 (pages 23-26) for repeatedly releasing NOx adsorbed by the NOx catalyst every first interval outside the temperature range where SOx is releasable, and separate SOx regeneration control means independent from said NOx regeneration control means for repeatedly releasing SOx adsorbed by the NOx catalyst every second interval, said second interval being longer than the

first interval and determined independently from said first interval.

Dependent Claim 3. Claim 3 is directed to an embodiment where an amount of oxygen adsorbed on the light-off catalyst is not greater than about 150 cc per one-liter volume of the catalyst when measured by an oxygen pulse method. Page 12, lines 27-33; page 16, lines 15-22; page 17, lines 5-32; page 18, lines 1-9.

Dependent Claim 4. Claim 4 is directed to an embodiment where an oxygen component stored in the light-off catalyst is not greater than about 25 g per one-liter volume of the catalyst. Page 18, lines 1-9.

Dependent Claim 6. Claim 6 is directed to an embodiment where an amount of oxygen adsorbed on the three-way catalyst of the exhaust gas purifying means is not greater than about 150 cc per one-liter volume of the catalyst when measured by an oxygen pulse method. Page 6, lines 22-31.

Dependent Claim 7. Claim 7 is directed to an embodiment where an oxygen component stored in the three-way catalyst of the exhaust gas purifying means is not greater than about 25g per one-liter volume of the catalyst. Page 6, lines 22-34.

Dependent Claim 8. Claim 8 is directed to an embodiment where the internal combustion engine is a spark ignition type four-cycle engine that operates on the four-stroke cycle consisting of a suction stroke, compression stroke, combustion/expansion stroke, and exhaust stroke. Page 8, lines 25-34.

Dependent Claim 9. Claim 9 is directed to an embodiment where the internal combustion engine is an in-cylinder injection type engine in which fuel is directly injected into a combustion chamber. Page 35, lines 19-23.

Dependent Claim 18. Claim 18 is directed to an embodiment where the light-off catalyst has a reduced O_2 storage capability per one liter volume of the catalyst. Page 12, lines 27-33.

Dependent Claim 24: Claim 24 is directed to control means for recovering the NOx catalyst by reducing the oxygen concentration in the exhaust gas such that the CO that has passed through said light-off catalyst is introduced to the NOx catalyst when a NOx conversion efficiency of the NOx catalyst is decreased and maintaining the reduced oxygen concentration until the absorbed NOx in the NOx catalyst is released outside the temperature range where SOx is releasable, calculating the NOx conversion efficiency after the recovery, and regenerating the NOx catalyst to release SOx only when the NOx conversion efficiency, calculated after the recovery,

is less than a threshold value. Page 23, lines 20-29; page 30, line 25 - page 31; page 33, lines 1-21.

VI. Grounds of Rejection to be Reviewed on Appeal

The Final Rejections to be reviewed by the Board are the following:

(1) Claims 8-21 and 23 stand rejected under 35 USC 103(a) as being unpatentable over Murachi et al '989 in view of Hepburn '788.

(2) Claims 3-4 and 6-7 stand rejected under 35 USC 103(a) as being unpatentable over Murachi et al in view of Hepburn '788 and design choice.

(3) Claim 24 stands rejected under 35 USC 103(a) as being unpatentable over Murachi et al in view of Hepburn '788 and '084.

VII. Argument

A. Issue Presented for Appeal

The issue presented for appeal is whether the Examiner has presented a *prima facie* case of obviousness based on the combined teachings of the Murachi et al '989, Hepburn '788, Hepburn '084 references, and design choice.

B. Argument in Support of Patentability

1. Rejection of Claims 8-21 and 23 under 35 USC 103(a)

Claims 8-21 and 23 stand rejected under 35 USC 103(a) as being unpatentable over Murachi et al '989 in view of Hepburn '788.

Claim 23

In support of the rejection, the Examiner takes the position that Murachi et al teaches an exhaust gas purifying apparatus of an internal combustion engine comprised of (a) a light-off catalyst 5 provided in an exhaust passage, (b) exhaust gas purifying means 9 provided in the exhaust passage downstream of the light-off catalyst, (c) NOx control means 20,4 for repeatedly releasing NOx adsorbed by the NOx catalyst every first interval (2 minutes) and SOx control means 20,4 repeatedly releasing SOx adsorbed by the NOx catalyst every second interval (every 60 minutes) *independent from and longer than the first interval.*

As admitted by the Examiner, Murachi et al fails to teach or suggest the limitation where the oxygen storage capability of the light-off catalyst is less than the oxygen storage capability of the three-way catalyst per one-liter volume of each catalyst as set forth in appellants' amended claim 23.

The limitation in claim 23 wherein the light-off catalyst "has limited O_2 storage capability such that the light-off catalyst

passes therethrough at least CO in an exhaust gas to a downstream side of the light-off catalyst when the internal combustion engine is operating under a condition where the oxygen concentration of the exhaust gas is reduced" is also, contrary to the assertion of the Examiner, not taught by Murachi et al. Indeed, the Examiner's reliance upon the disclosure of Murachi et al (line 66 of column 3 to line 8 of column 4, and lines 29 to 38 of column 6) on this point is misplaced.

As is well known, a three-way catalyst exhibits acceptable exhaust gas purifying performance when the air-fuel ratio is close to the stoichiometric ratio, and it is further well known that the exhaust gas purifying performance deteriorates when the air-fuel ratio is lean or rich. Namely, as is set forth at page 3, lines 8 to 25 of the specification, it is possible to feed HC and CO, which have not been purified by the light-off catalyst, downstream of the light-off catalyst by making the air-fuel ratio rich <u>without</u> reducing the oxygen storage capability.

Murachi et al operates in a manner consistent with the prior art as disclosed at page 3, lines 8-25 of the specification. As a result, the Examiner's view is incorrect that Murachi et al discloses that the presence of HC or CO in the exhaust gas downstream of the light-off catalyst reduces the oxygen storage capability per one-liter volume of the light-off catalyst.

Accordingly, Murachi et al neither discloses nor suggests the reduction of the oxygen storage capability per one-liter volume of the light-off catalyst.

With regard to the limitation directed to separate and distinct NOx and SOx control means, appellants also disagree with the position of the Examiner.

Claim 23, the sole independent claim under rejection, contains the following limitation:

> NOx regeneration control means for repeatedly releasing NOx adsorbed by the NOx catalyst every first interval outside the temperature range where SOx is releasable, and separate SOx regeneration control means independent from said NOx regeneration control means for repeatedly releasing SOx adsorbed by the NOx catalyst every second interval, said second interval being longer than the first interval and determined independently from said first interval.

The Examiner takes the position that Murachi et al teaches an exhaust gas purifying apparatus of an internal combustion engine comprised of (a) a light-off catalyst 5 provided in an exhaust passage, (b) exhaust gas purifying means 9 provided in the exhaust passage downstream of the light-off catalyst, (c) NOx control means 20,4 for repeatedly releasing NOx adsorbed by the NOx catalyst every first interval (2 minutes) and (d) SOx control means repeatedly releasing SOx adsorbed by the NOx catalyst every second interval (every 60 minutes) independent from and longer than the first interval.

Appellants initially note that NOx control means 20,4 of the reference is defined at column 3, lines 34-64 as "control circuit 20" and "injection valve 4." At column 3, lines 54-56 the control circuit is described as being directed to "an operation for causing NOx absorbent to release the absorbed NOx" which is "referred to as 'a regeneration of the NOx absorbent'."

Murachi et al describes at column 8, lines 49-64 the circumstances under which SOx may additionally be removed from the absorbent together with NOx that has also been absorbed:

> "Therefore, if the normal regenerating operation in which the air-fuel ratio of the exhaust gas is enriched is conducted, sulfate is not released from the absorbent. This causes accumulation of the SO_3 in the NOx absorbent 9, and eventually causes saturation of NOx absorbent 9 with SO_3. If the saturation of NOx absorbent 9 with the absorbed SO_3 occurs, the absorbing capacity of the NOx absorbent for both SO_3 and NOx decreases largely. Therefore, the NOx absorbent 9 is regenerated at an exhaust gas temperature higher than that in the normal regenerating operation during the regenerating operation of the DPF 7 to release sulfate, as well as NOx from the NOx absorbent 9. By regenerating the NOx absorbent 9 at a high exhaust gas temperature, SO_3 absorbed in the absorbent is released in the form of SO_2 and thereby, the absorbing capability of the NOx absorbent 9 is maintained."

The reference further states at the paragraph bridging columns 12 and 13 as follows regarding NOx and SOx release:

> "Further, if the periods of the regenerating operations of the DPF 7 and NOx absorbent 9 (TD_0 and TN_0) are set to about 3 minutes and 0.5 seconds, respectively, the regenerating operation of the NOx absorbent 9 is always conducted once or twice during

> the regenerating operation of the DPF as shown in FIG. 5. Therefore, by setting the timing of the regenerating operations of the DPF 7 and NOx absorbent 9, the NOx absorbent 9 is regenerated periodically by the exhaust gas having a temperature higher than that of the normal regenerating operation and thereby, SO_3 (sulfate) as well as NOx is released from the NOx absorbent 9 periodically. Thus, the absorbing capacity of NOx absorbent 9 can be maintained at a high level."

The Examiner asserts that Murachi et al teaches that a NOx release control is performed every first interval (2 minutes), and that a SOx release control is performed every second interval (60 minutes). However, the NOx release control and SOx release control are <u>not</u> performed independently and distinct of each other as a result of the action of separate and independent NOx release control means and SOx release control means.

Instead, SOx release occurs as a result of the use of higher temperature exhaust gas <u>for NOx regeneration</u>, which concurrently results in SOx removal. Separate <u>and</u> independent NOx and SOx regeneration control means are <u>not</u> provided by Murachi - indeed, the Examiner asserts that control means 20,4 constitute the requisite control means. It is clear that control means 20,4 cannot constitute distinct and independent control means for both NOx and SOx as recited in claim 23, particularly in view of the description of the method of operation in Murachi et al.

In support of his position, the Examiner states that, since in Murachi et al it is possible to release NOx even when SOx release control is not taking place, then SOx release control and NOx release control in Murachi et al are "independent from" each other. The Examiner's position on this point is not supported by the teachings of the reference.

The expression "control is performed independently" in claim 23 means that a SOx release control is performed even under those conditions where NOx release control cannot be performed - in other words, wherein the instruction to perform a SOx release control and the instruction to perform a NOx release control are independent from each other.

In Murachi et al, when NOx release control and DPF regeneration control coincide, SOx release control is performed at the same time. The system of the reference is configured so that SOx release is automatically performed when the command for NOx release is given under certain conditions as discussed above. However, there exists no teaching in Murachi et al regarding the use of control means to conduct SOx release control absent NOx release.

Thus, to perform SOx release according to the teachings of Murachi et al, it is essential that NOx release be performed at the same time - the reference makes clear that SOx release thus does

not occur without NOx release being also performed at the same time.

Accordingly, since, in Murachi et al, NOx release is essential for the execution of SOx release, it is not correct to conclude that SOx release control and NOx release control either could or should be carried out "independently from" each other. The Examiner points to no portion of Murachi et al that suggests that such an embodiment could or should be employed. Indeed, such an embodiment is inconsistent with the teachings of Murachi et al.

This means that Murachi et al neither describes nor suggests the execution of NOx and SOx release control *independent from* each other as claimed by appellants, and certainly fails to teach or suggest the "regeneration control" limitation of claim 23.

Given the failure of Murachi et al to teach or suggest the "regeneration control means" limitation, and given the fact that the remaining references relied upon by the Examiner are not relied upon to teach this limitation, and as Murachi et al is relied upon as the primary reference in support of this rejection, appellants believe the rejection is without basis.

Claim 18

With respect to claim 18, the Examiner acknowledges that the apparatus of Murachi et al fails to disclose the fact that the

exhaust gas purifying means (9) has an oxygen storage capacity greater than that of the light-off catalyst (5). The Examiner takes the position that it is easy for those with ordinary skill in the art to reduce the oxygen storage capability of a light-off catalyst (5) that is of small size with respect to the exhaust gas purifying means (9). Appellants believe the conclusion of the Examiner to be without basis.

It is a matter of course that, when a catalyst is small, the oxygen storage capability for the entire volume of the catalyst becomes small as long as the oxygen storing material composition is the same. It should be noted, however, that what is discussed in the invention of the present application is the oxygen storage capability *per one-liter volume of the catalyst*, and thus what is compared is <u>not</u> simply the amount of the oxygen component stored in the light-off catalyst (5) and that in the exhaust gas purifying means (9). In other words, even if the amount of the oxygen component stored in the light-off catalyst (5) is less than that in the exhaust gas purifying means (9), the oxygen storage capability of the light-off catalyst (5) can be higher than that of the exhaust gas purifying means (9). Hence, the prior conclusion of the Examiner used in support of the rejection of claim 18 is ill-founded, and the rejection should be found to be improper.

Claim 8

The Examiner also recognizes that Murachi et al does not disclose the spark ignition type four-cycle engine set forth in claim 8. However, the Examiner states that "both 'spark-ignition engine' and 'diesel engine' generate exhaust gases containing the same harmful emissions". The Examiner accordingly takes the position that it would have been obvious to one having ordinary skill in the art at the time the invention was made to apply the invention of Murachi et al to a spark ignition type engine as claimed.

In response, appellants disagree with the position of the Examiner. Certainly, the exhaust gas composition is similar for the diesel engine and the spark-ignition engine. However, one of the main differences between the two types of engines lies in the fact that, while in the case of diesel engine soot is present, in the case of spark-ignition engine substantially <u>no</u> soot is present. Thus, while the diesel engine essentially requires a filter such as DPF, etc. for capturing soot, such a filter is not required for the spark-ignition engine and is accordingly not employed.

In the invention of Murachi et al, SOx release control is performed when the DPF regeneration control <u>and</u> the NOx release control coincide. But if the invention of the present invention relates to a spark-ignition engine, the DPF regeneration control is

not present. In other words, the teachings of Murachi et al are not directly applicable to the spark-ignition engine of claim 8. The rejection of claim 8 is thus without basis.

Claim 9

With regard to claim 9, the Examiner states that "the internal combustion engine is an in-cylinder type engine in which fuel is directly injected into a combustion chamber". However, claim 9 of the invention of the present application is dependent on claim 8 which is directed to the use of a gasoline engine. As discussed hereinabove, claim 8 of the invention of the present application cannot be easily arrived at from the teachings of Murachi et al, and claim 9, which is dependent on claim 8, is also distinguishable over the reference. The rejection of claim 9 is thus without basis.

2. Rejection of Claims 3-4 and 6-7 under 35 USC 103(a)

Claims 3-4 and 6-7 stand rejected under 35 USC 103(a) as being unpatentable over Murachi et al in view of Hepburn '788 and design choice.

Claims 3-4

With regard to claims 3-4, the Examiner acknowledges that Murachi et al fails to suggest the limitation where the difference in the amount of oxygen adsorbed on the light-off catalyst is not greater than 150 cc per one-liter volume of the catalyst, and the amount of oxygen stored in the light-off catalyst is not greater than 25 g per one-liter volume of the catalyst.

However, the Examiner takes the position that one of ordinary skill in the art could arrive at the claimed embodiment as it "would be a function of many variables such as the size of the light-off catalyst, engine size, engine operating conditions (load, speed, etc.), air and fuel properties, capacity and size of a main catalyst, etc." The Examiner also states that there is nothing in the specification which establishes that these claimed amounts of oxygen bring about unexpected results.

However, as is clearly set forth in Fig. 10 of the specification, with the amount of oxygen adsorbed on the light-off catalyst being 150 cc per one-liter volume of the catalyst and the amount of oxygen component stored in the light-off catalyst being 25 g per one-liter volume of the catalyst, the time required for making the air-fuel ratio rich can be reduced as much as by 60% compared with the period obtained by a catalyst whose adsorbed amount of oxygen exceeds 300 cc per one-liter volume of the

catalyst. This showing confirms that the claimed embodiment is in fact not a matter of routine experimentation or optimization as asserted by the Examiner. The Examiner fails to address this point which was previously argued by applicants. Nor has the Examiner presented a *prima facie* case of obviousness based on his dismissal of the limitations of the claims 3-4.

Claims 6-7

As to claims 6-7, the Examiner acknowledges that Murachi et al does not teach that an amount of oxygen absorbed on the three-way catalyst of the exhaust gas purifying means is not greater than about 150 cc per one liter volume of the catalyst, and that an oxygen component stored in the three-way catalyst is not greater than 25 g per one-liter volume of the catalyst.

However, the Examiner takes the position that one of ordinary skill in the art could arrive at the claimed embodiment as it "would be a function of many variables such as the size of the light-off catalyst, engine size, engine operating conditions (load, speed, etc.), air and fuel properties, capacity and size of a main catalyst, etc." The Examiner also states that there is nothing in the specification which establishes that these claimed amounts of oxygen bring about unexpected results.

The Examiner's dismissal without factual basis of the limitations of claims 6-7 results in the failure of the Examiner to present a *prima facie* case of obviousness.

3. Rejection of Claim 24 over Murachi in view of Hepburn '788/'084

Claim 24 stands rejected under 35 USC 103(a) as being unpatentable over Murachi et al in view of Hepburn '788 and '084. This rejection respectfully is traversed.

The Examiner takes the view that claim 24 can be easily derived in view of the combined teachings of Murachi et al and Hepburn. Hepburn teaches that SOx control is conducted after the NOx release control.

The basic issue to be addressed is whether the conditions under which SOx regeneration occurs in Hepburn meet the limitations of claim 24. Indeed, the references do not contemplate "maintaining the reduced oxygen concentration until the absorbed NOx in said NOx catalyst is reduced outside the temperature range where SOx is releasable" as recited in claim 24.

As with the above-discussed rejections, the Examiner fails to present a *prima facie* case of obviousness, and the rejection should be found to be improper.

VIII. Conclusion

In view of the above, the rejections under 35 USC 103(a) should be found to be without basis, and reversed by the Honorable Board.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By #28,808 fr
Terrell C. Birch, #19,382

P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

TCB:JWH/sh

CLAIMS APPENDIX

3. The exhaust gas purifying apparatus as defined in claim 23, wherein an amount of oxygen adsorbed on said light-off catalyst is not greater than about 150 cc per one-liter volume of the catalyst when measured by an oxygen pulse method.

4. The exhaust gas purifying apparatus as defined in claim 3, wherein an oxygen component stored in said light-off catalyst is not greater than about 25 g per one-liter volume of the catalyst.

6. The exhaust gas purifying apparatus as defined in claim 23, wherein an amount of oxygen adsorbed on the three-way catalyst of said exhaust gas purifying means is not greater than about 150 cc per one-liter volume of the catalyst when measured by an oxygen pulse method.

7. The exhaust gas purifying apparatus as defined in claim 6, wherein an oxygen component stored in the three-way catalyst of said exhaust gas purifying means is not greater than about 25g per one-liter volume of the catalyst.

8. The exhaust gas purifying apparatus as defined in claim 23, wherein the internal combustion engine is a spark ignition type four-cycle engine that operates on the four-stroke cycle consisting

of a suction stroke, compression stroke, combustion/expansion stroke, and exhaust stroke.

9. The exhaust gas purifying apparatus as defined in claim 8, wherein the internal combustion engine is an in-cylinder injection type engine in which fuel is directly injected into a combustion chamber.

10. The exhaust gas purifying apparatus as defined in claim 23, wherein the exhaust gas purifying means is a single catalyst.

11. The exhaust gas purifying apparatus as defined in claim 10, wherein the single catalyst of the exhaust gas purifying means includes a function of the three-way catalyst.

12. The exhaust gas purifying apparatus as defined in claim 10, wherein the light-off catalyst includes a single catalyst that functions as the three-way catalyst.

13. The exhaust gas purifying apparatus as defined in claim 12, wherein the exhaust gas purifying means further functions also as the NOx catalyst.

14. The exhaust gas purifying apparatus as defined in claim 13, wherein the light off catalyst functions also as an SOx catalyst.

15. The exhaust gas purifying apparatus as defined in claim 23, wherein said condition where the oxygen concentration of the exhaust gas is reduced includes at least one of a stoichiometric operating condition and a fuel rich operating condition.

16. An exhaust gas purifying apparatus as defined in claim 23, wherein said light-off catalyst mainly purifies HC in an exhaust gas emitted from the engine in a cold state.

17. An exhaust gas purifying apparatus as defined in claim 23, wherein said light-off catalyst is provided in the exhaust passage immediately downstream of the internal combustion engine.

18. An exhaust gas purifying apparatus as defined in claim 23, wherein said light-off catalyst has a reduced O_2 storage capability per one liter volume of the catalyst.

19. An exhaust gas purifying apparatus as defined in claim 18, wherein said light-off catalyst includes a three-way catalyst.

20. An exhaust gas purifying apparatus as defined in claim 18, wherein said light-off catalyst includes an oxidizing catalyst.

21. An exhaust gas purifying apparatus as defined in claim 18, wherein said control means sets the air-fuel ratio leaner as compared to an air-fuel ratio required to release the adsorbed NOx

from the NOx catalyst when the NOx catalyst is used in conjunction with a three-way catalyst in which the O_2 storage capability is not reduced.

23. An exhaust gas purifying apparatus of an internal combustion engine, comprising:

a light-off catalyst provided in an exhaust passage and having an O_2 storage capability such that said light-off catalyst passes, there through, at least CO in an exhaust gas to a downstream side of said light-off catalyst when the internal combustion engine is operating under a condition where the oxygen concentration of the exhaust gas is reduced;

exhaust gas purifying means provided in the exhaust passage at a downstream position of and in series with said light-off catalyst, said exhaust gas purifying means having a NOx catalyst for adsorbing NOx in the exhaust gas when an air-fuel ratio of the exhaust gas is lean and releasing the adsorbed NOx when the oxygen concentration of the exhaust gas is reduced, said exhaust gas purifying means further having a three-way catalyst that reacts with the released NOx;

wherein the light-off catalyst has an oxygen storage capability of a first value and the three-way catalyst of the

exhaust gas purifying means has an oxygen storage capability of a second value greater than said first value, said first and second values being per one liter of catalyst;

and

NOx regeneration control means for repeatedly releasing NOx adsorbed by the NOx catalyst every first interval outside the temperature range where SOx is releasable, and separate SOx regeneration control means independent from said NOx regeneration control means for repeatedly releasing SOx adsorbed by the NOx catalyst every second interval, said second interval being longer than the first interval and determined independently from said first interval.

24. An exhaust gas purifying apparatus as claimed in claim 23, comprising control means for recovering the NOx catalyst by reducing the oxygen concentration in the exhaust gas such that said CO that has passed through said light-off catalyst is introduced to said NOx catalyst when a NOx conversion efficiency of the NOx catalyst is decreased and maintaining the reduced oxygen concentration until the absorbed NOx in said NOx catalyst is released outside the temperature range where SOx is releasable,, calculating the NOx conversion efficiency after the recovery, and regenerating the NOx catalyst to release SOx only

when the NOx conversion efficiency, calculated after the recovery, is less than a threshold value.

EVIDENCE APPENDIX

No evidence has been made of record.

RELATED PROCEEDINGS APPENDIX

No related proceedings exist.